

## **Camera Arrangement for Motor Vehicles**

[0001] This nonprovisional application claims priority under 35 U.S.C. § 119(a) on German Patent Application No. 102 37 608.5 filed in Germany on August 16, 2002, which is herein incorporated by reference.

### **BACKGROUND OF THE INVENTION**

#### Field of the Invention

[0002] The present invention relates to a camera arrangement for motor vehicles, with a camera that is arranged behind a window (windshield).

#### Description of the Background Art

[0003] A camera arrangement is taught in DE 40 16 570 A1, for example. However, a problem in camera arrangements of this nature is fogging on the inside surface of the window, which is caused by condensation of water vapor on the relatively cold glass in the vehicle interior, especially in winter. A fogged interior window surface seriously impairs image acquisition by the camera, or even makes it impossible.

### **SUMMARY OF THE INVENTION**

[0004] It is therefore an object of the present invention to provide a camera arrangement such that fogging on the interior surface of the window is prevented in the camera's field of view.

[0005] The idea upon which the invention is based to attain this object is in arranging a transparent additional window behind and a distance away from the windshield, at least in the portion of the windshield viewed by the camera, so that a layer of air is enclosed between the window and the additional window. This layer of air functions as a thermally insulating layer, achieving the result that the temperature of the additional window never differs very strongly from the temperature of the vehicle interior, even when the windshield is very cold. In other words, the temperature of the enclosed layer of air remains substantially the same as the ambient temperature of the vehicle interior. Consequently, condensation from water vapor on the additional window is avoided, since the window does not represent a "cold trap" in the vehicle interior. In addition, the volume of air enclosed between the windshield and the additional window is so small that the absolute quantity of water vapor present in this volume is not enough to form fogging that would impair the camera's view.

[0006] Tests in an environmental chamber demonstrated that the fog-inhibiting effect occurs reliably when the distance between the windshield and additional window is less than 3 mm. In particular, the fog-inhibiting effect is especially good at a distance between 1 mm and 2 mm, because a sufficiently thick layer of air is present for thermal insulation on the one hand, and on the other hand the enclosed volume of air and the absolute quantity of moisture thus enclosed is sufficiently small.

[0007] Further scope of applicability of the present invention will become apparent from the detailed description given hereinafter. However, it should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus, are not limitive of the present invention, and wherein:

[0009] Fig. 1 is a cross-section of a camera arrangement according to a preferred embodiment of the invention;

[0010] Fig. 2 is a perspective view of a cover upon which is arranged a camera that is attached behind an additional window in accordance with a preferred embodiment of the invention; and

[0011] Fig. 3 is a top view of the optical window of the cover.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] The camera arrangement according to the invention is shown in Fig. 1. The camera arrangement includes a transparent additional window 3, which preferably is made of plastic, and is arranged a distance A in front of a windshield 2 so that a layer of air 3A is enclosed between the windshield 2 and the additional window 3. The additional window 3 extends at least across the area of the windshield 2 that is viewed by a camera 1. In other words, the additional window 3 may have a greater area than the camera viewing area that is incident on the windshield 2.

[0013] The use of plastic (instead of glass) for the additional window 3 has, in addition to manufacturing considerations, the advantage that the thermal conductivity of plastic is significantly less than that of glass, so that the thermal

insulation by the additional window 3 itself is added to the very good thermal insulation by the layer of air.

[0014] In order to fasten the additional window 3 to the windshield 2 at a distance therefrom, a mounting ring 5 is preferably provided on which the additional window 3 rests. Naturally, it is not necessary for the mounting ring 5 to be a circular ring. A rectangle, trapezoid or any other kind of shape is equally possible. The mounting ring 5 itself is preferably glued to the inner surface of the windshield 2. To accommodate the additional window 3 in a fixed position, the inside of the mounting ring 5 has a step 7, which forms a support shoulder for the additional window 3. The position of the additional window 3 is laterally fixed by the inner wall of the mounting ring 5 in the area of the step 7.

[0015] In order to avoid the entry of undesired light (for example, light from the vehicle interior reflected from the additional window) into the camera objective lens 1A, it is advantageous to provide a light-tight cover 4 that can be funnel-shaped and that surrounds the space between the windshield 2 and the camera objective lens 1A in a light-tight manner with the exception of a light-admitting opening 4A facing the windshield, as shown in Figs. 2 and 3. The camera 1, specifically the camera objective lens 1A, is arranged in an end of the light-tight cover 4 facing away from the windshield 2. The additional window 3 in accordance with the invention is arranged in front of the light-admitting opening 4A of the light-tight cover 4 and seals it such that a second volume of air 4C is enclosed in the light-tight cover 4 behind the additional window 3. In this way, the light-tight cover 4 is preferably also sealed in a dust-tight manner, avoiding undesirable dust deposits on the camera objective 1A and the additional window 3. Here, an edge 4B surrounding the light-admitting opening 4A of the cover 4 rests against the additional window 3. Since the air volume 4C in the funnel-shaped cover 4 is relatively large, the latter preferably has a membrane 4D that is permeable to water vapor to reliably prevent the exit of moisture and thus the fogging of the additional window 3 even under the

most adverse conditions. The light-tight cover 4, which tapers away from the windshield 2, also defines the field of view of the camera 1, e.g. the viewing angle of the camera.

[0016] In one embodiment, the additional window 3 is permanently attached to the mounting ring 5. This can be accomplished, for example, by gluing the additional window 3 to the mounting ring 5, or by ultrasonic or laser-beam welding of the two plastic parts, or by manufacturing the two parts from plastic as a single piece by injection molding, where the mounting ring 5 is preferably made of a non-transparent plastic material and the additional window 3 is made of a transparent plastic material. In this embodiment, the light-tight cover 4 is either glued to the additional window 3 or is pressed against the additional window 3 by a spring 6 provided between the mounting ring 5 and the light-tight cover 4.

[0017] In another embodiment, the light-tight cover 4 including the additional window 3 is manufactured from plastic as a single piece in a two-component injection molding process, in which the light-tight cover 4 is produced from a non-transparent plastic material, and the additional window 3 is produced from a transparent plastic material. In this embodiment, the additional window 3 that is designed as one piece with the light-tight cover 4 is either glued to the mounting ring 5 or can be pressed against the mounting ring 5 by the spring 6, which is between the mounting ring 5 and the light-tight cover 4.

[0018] In another embodiment, the light-tight cover 4 including the additional window 3 and the mounting ring 5 is produced from plastic as a single piece by a two-component injection molding process in which the light-tight cover 4 is produced from a non-transparent plastic material, while the additional window 3 is produced from a transparent plastic material. The mounting ring 5 here is likewise preferably produced from a non-transparent plastic material. Furthermore, the mounting ring 5, the additional window 3,

and the light-tight cover 4, which are produced as a single piece, can be glued to the windshield 2.

[0019] In a further embodiment, the additional window 3 is placed loosely in the mounting ring 5 and is held there by pressure from the light-tight cover 4, which is produced by the spring 6 that is provided between the mounting ring 5 and the light-tight cover 4.

[0020] Where the foregoing discussion mentions transparent, this means either transmissive for light in the visible spectrum and/or transmissive for infrared light. The latter is especially relevant to camera arrangements for night-vision devices in motor vehicles, for example.

[0021] The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are to be included within the scope of the following claims.